Development of Strong Ground Motion Simulation System based on Multi-Scale Analysis and Geographical Information System

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Strong ground motion information with high resolution and high accuracy could have significant role for making rational and efficient countermeasures against earthquake disaster. In order to obtain reliable strong ground motion information, it is necessary to simulate, with 3-D numerical simulation model, the fault mechanism, the wave propagation through the heterogeneous crust and amplification near the surface. There is, however, two major difficulties: (i) requirement of huge computation; (ii) lack of soil-crust structures information.

For resolving these two difficulties, we propose a new analysis method, *macro-micro analysis method* (MMAM), and develop strong ground motion simulation system based on geographical information system (GIS) and the MMAM. The MMAM takes advantage of the singular perturbation expansion (SPE) and the bounding media theory (BMT). The SPE can reduce required numerical computation due to the efficient multi-scale analysis and the BMT can deal with the uncertainty of soil-crust structures information. This strong ground motion simulation system contains the following components: 1) wave propagation simulation software; 2) modeling software for 3-D soil-crust structures; 3) database for borehole data; 4) interface softwares for application of the MMAM. Mature combination of these components can provide efficient estimation system for strong ground motion information.

In order to verify the effectiveness of this strong ground motion simulation system, the earthquakes observed in Yokohama City are simulated, and the reproduction of the strong ground motion is attempted. The simulation result is compared with the data observed. It is shown that it succeeded in reproducing the velocity spectrum of each place in frequency domain where the calculation accuracy is guaranteed. In addition, the maximum velocity distribution of each every site is also calculated with the spatial resolution of 1[m] order. These results clearly show the effect of soil-crust structures (material property and topography) on the strong ground motion. And it is confirmed that large-scale numerical simulation is necessary in order to predict the strong motion with high spatial resolution in the sufficient accuracy.

References

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